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CENTRAL INTELLIGENCE AGENCY
INFORMATION FROM
FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT
CD NO.

50X1-HUM

COUNTRY USSR
SUBJECT Scientific - Electronics, instrumentation
HOW PUBLISHED Monthly periodical
WHERE PUBLISHED Moscow
DATE PUBLISHED Jan 1950
LANGUAGE Russian

DATE OF INFORMATION 1949
DATE DIST. 9 Aug 1950
NO. OF PAGES 2
SUPPLEMENT TO REPORT NO.

SOURCE Promyshlennaya Energetika, No 1, 1950.

A SOVIET AUTOMATIC PHOTOELECTRIC PYROMETER

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The methods used at many enterprises for heat control when hardening high-speed steel tools, using high-frequency currents, "according to time," are not satisfactory for high-quality parts and cause considerable production rejects due to possible line voltage fluctuations and for other reasons.

The difficulties of such control are rendered still more complicated by the circumstance that the hardening temperature of high-speed steels is very near the melting point.

The authors have designed and introduced into a number of shops of the Plant imeni Molotov, an automatic photopyrometer, the FEP-1, which is used when hardening high-speed steels in high-frequency installations. This instrument automatically stops the heating process when the required temperature has been attained by shutting off the supply to the high-frequency installation.

The photoelectric pyrometer consists of two main parts: the photoelectric cell head and the relay tube circuit.

The TsV-4 photoelectric cell is housed in an aluminum case. In front of the photoelectric cell there is mounted an optical lens, whose focus is behind the cathode of the photoelectric cell. The diameter of the image on the cathode is 14 - 16 millimeters. There is a protective glass in front of the lens and a diaphragm between the two which permits the tuning accuracy of the instrument to be regulated depending on the temperature. The photoelectric cell is connected with the amplifier by a two-strand armored cable.

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The main parts of the photopyrometer are: the photopyrometer amplifier, which consists of two electron tubes, a 6Zh7 and a TG-212 thyratron; an F-TsV-4 photoelectric cell; two full wave rectifier tubes (6 X 6); and a 220/380-volt power transformer, with separate windings for the thyratron and the cathodes of the other tubes. The relay and contactor are connected in the plate circuit of the thyratron.

The whole circuit is switched on when the starting button of the contactor is pressed. At the same time, the high frequency generator is switched on: this produces rapid heating of the part. The radiation from the heated metal is picked up by the photoelectric cell. The resulting current is amplified and applied to the grid of the thyratron, causing the latter to fire and thereby actuating the relay which switches off the heating circuits. To renew this cycle of hardening, it is necessary to press the starting button again.

Voltage changes have negligible effect on the apparatus with regard to the hardening temperature, which is held to within 2.1 percent of the set value. The minimum stable operating temperature of the instrument, when the photopyrometer head is 600 millimeters from the part being heated, is 800 degrees centigrade. By decreasing the distance to 400 millimeters, it is possible to obtain stable operation at 600 degrees. The maximum temperature is 1,300 degrees.

By using diaphragms or increasing the distance between the photoelectric cell and the part being heated, it is possible to increase considerably the upper limit of hardening temperature, which is important when hardening special kinds of high alloy steels.

The introduction of this instrument in the Plant imeni Molotov has reduced the rejects in hardening more than seven times and has resulted in power savings. The photopyrometer is also being used successfully at the "Krasnaya Etna" Plant, a milling machine plant, etc., and should be industrially applied on a wide scale as soon as possible.

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